

**AVAILABILITY, ACCESSIBILITY AND HOUSEHOLD HANDLING
PRACTICES OF TRADITIONAL LEAFY VEGETABLES:
A CASE OF LINDI REGION**

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**A DISSERTATION SUBMITTED IN PARTIAL FULFILMENT OF THE
REQUIREMENTS FOR THE DEGREE OF MASTER OF SCIENCE IN HUMAN
NUTRITION OF SOKOINE UNIVERSITY OF AGRICULTURE.
MOROGORO, TANZANIA.**

2020

ABSTRACT

In Sub-Saharan Africa Tanzania inclusive, most of the diet consumed is cereal based which contains low micronutrients and phytochemicals; vitamins, beta-carotene as well as carotenoids which are found more in Traditional Leafy Vegetables (TLVs). Micronutrients deficiency is a major health problem in developing country including Tanzania due to poor dietary diversity among other causes. The study aims to explore the availability, accessibility and household handling practices of TLVs. The study employed a cross-sectional qualitative-explorative study design which mainly involved KII, FGDs and market survey. A stratified multistage sampling approach was used in selecting respondents. Data were analyzed by using NVivo 12, qualitative data analysis software (QDAS). Result obtained showed that most of the participants for both KII and FGDs ranged between of 20-30 years of age. TLVs were mentioned to be mostly available during rainy season and became more scarcity during dry season which lead to high price and low diversification of TLVs. There are few participants who locally process TLVs like cowpea leaves and jute mallow (*linyororo*) and obtain the end product as dried cowpea leaves and Jute mallow (*linyororo*). Different preparation and cooking methods were mentioned which include; boiling and prolonged cooking while covering the vegetables. Climatic change, use of local seed and lack of market information mentioned to be the factors affecting the availability and accessibility of TLVs. Therefore, the study revealed that TLVs are available and they are highly accessible during the rainy season but became less available during dry season which lead to the increasing in the scarcity and price as well as insufficiency knowledge on preparation and cooking methods of TLVs. There is a need to integrate preparation and cooking practices with agriculture interventions to equip rural household farmers with the knowledge on how to prepare food without losing important nutrients like vitamins which are easily lost.

DECLARATION

I, BEATRICE MICHAEL SARIA, do declare to the Senate of Sokoine University of Agriculture that this dissertation is my own original work done within the period of registration and that it has neither been submitted nor concurrently being submitted in any other institution.

Beatrice Michael Saria
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Date

The above declaration is confirmed by;

Dr. Mbwana H
(Supervisor)

Date

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ACKNOWLEDGMENT

Utmost thanks to the almighty God for my life and good works he has done in it and makes it possible. With heartfelt joy, I thank my supervisor Dr. Hadijah Mbwana for the immense support during this study. Thank you for bringing me to alight when I did not understand much of these concepts and for keeping your doors open when I had millions of question and seemed to be green, your objective, criticisms, advice and patience helped me so much during this study.

Special thanks to my parents Michael I. Saria and Mary Saria, my brother and sisters for their love and support all the way, you people are so great I could never wish for a better family. To my friends Diana Sehaba and Maria Komba thank you for keeping smile on my face whenever things went wrong. I owe my profound gratitude to Madam Zahra Majili and Mr. Basil Msuha who took keen interest in my work and unlisted support till its completion. Finally, I place my sense of gratitude to VEG-LEG project coordinator, all farmers in Lindi region and all the people who directly or indirectly participated in this study.

DEDICATION

This work is dedicated to my lovely parents Michael I. Saria and Mary Saria who encourage and pray for me. To my lovely brother and sisters for encouragement, love and support.

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LIST OF ABBREVIATIONS

DAICO	District Agriculture Irrigation and Cooperative Officer
TLVs	Traditional Leafy Vegetables
QDAS	Qualitative data analysis software
KII	Key informant interview
FGDs	Focus group Discussions
WHO	World Health Organisation

CHAPTER ONE

1.0 INTRODUCTION

1.1 Background Information

In Sub-Saharan Africa Tanzania inclusive, most of the diet consumed is cereal based which contains low micronutrients and phytochemicals; vitamins, beta-carotene as well as carotenoids which are found more in Traditional Leafy Vegetables (TLVs) (Stangeland *et al.*, 2009; Uusiku *et al.*, 2010). These micro-elements in leafy vegetables are important for many biological function which include antioxidant and ant inflammatory (Moyo *et al.*, 2013). They play an important role in the balanced diet and they are advised to be consumed highly which may reduce the risk of diseases like cancer, coronary heart attack and diabetes (Stangeland *et al.*, 2009; Aregheore, 2012). TLVs are important sources of micronutrients including vitamins A and C, and minerals like iron and zinc (Lotter *et al.*, 2014). Micronutrients are required in the body in minimum amount but they are very important in proper vision, immune function and enhancing absorption of some nutrients in the body (Tumwet *et al.*, 2014). But no single TLVs can give all the nutrients required in the body, a diversification of the diet is required to meet the daily micronutrient requirement (Uusiku *et al.*, 2010).

Vegetables are the fresh and edible parts of herbaceous plants. They may include roots, stems, leaves, fruits or seeds of the plants that can be eaten as raw and/or in cooked form. Vegetables are a major part of daily food intake by humans with their main dishes all over the world. They are most readily available source of foods that can contribute significantly to human nutrition and health. They are biochemically essential and nutritionally important as they contain good amounts of carbohydrates, proteins, vitamins and minerals (Saikia and Deka, 2013). Traditional Leafy Vegetables (TLVs) refers to the vegetable or plants whose leaves, roots and fruits are acceptable and used as diet by the

people in both rural and urban area as the function of traditional, customs and sometimes as the habit of specific people in a certain area. They also have some medicinal values like antibacterial and anticancer activities that make them a valuable addition to the diet (Kumar *et al.*, 2013). TLVs are sources of high-quality nutrition (Abukutsa, 2007). They are easily accessible, inexpensive for poor people and they contain minerals and vitamins in levels exceeding those found in most exotic vegetables (Uusiku *et al.*, 2010; Singh *et al.*, 2013). In this regard, TLVs are anticipated to contribute significantly to the global initiative of WHO in increasing the consumption of fruits and vegetables in African countries (Smith and Eyzaguirre, 2007).

High marketing returns have motivated commercialization of TLVs by small-scale farmers, who produce and supply them either individually or collectively in groups (Ngugi *et al.*, 2007; Muhanji *et al.*, 2011; Weinberger *et al.*, 2011). TLVs production, especially in East and Southern Africa, has the potential to be highly profitable, increase employment opportunities, generate income and bring about an increasing commercialization of the rural sector (Weinberger and Lumpkin, 2007). This would however require that farmers and other value chain actors struggle to improve the competitiveness of their agricultural commodities so as to increase the market shares and profits. High percentage of fresh TLVs sold in urban markets is supplied from various rural areas at different periods of the year due to variation in production seasons (Ngugi *et al.*, 2007). TLVs are an important part of farming and consumption systems throughout Tanzania and crucial to food security particularly during shortage of rainfall, they are tolerant to pests and diseases as well as adaptive to low inputs agriculture.

In Tanzania, small scale farmers in the rural areas have high contribution of the most TLVs consumed by the urban residents. In Tanzania most of the consumers obtain major

part of their diet from vegetables which has shown to have significant role in human nutrition especially as an important source of essential minerals, vitamins, fibers, phytochemicals and antioxidants (Kimambo *et al.*, 2018). Therefore, TLVs are very important source of nutritional and food security especially in rural areas. Most of sub-Saharan African countries, Tanzania inclusive do not prioritize TLVs in their policies, crop research and training (Kimambo *et al.*, 2018). Consumption of TLVs in Tanzania is below the minimum recommended intake but there was some improvement from the year 2000 to 2007 from 113g to 200g per capita per day (Kimambo *et al.*, 2018). Eventually, most studies indicated that there is low consumption of TLVs by the rural areas which lead to the increase of nutritional deficiency disorders among vulnerable groups like women and children below five years of age (Ngugi *et al.*, 2007; Uusiku *et al.*, 2010; Kimambo *et al.*, 2018;). The consumption of TLVs is below the minimum recommended intake of 400g per capita per day (Kimambo *et al.*, 2018). Low consumption of TLVs could be due to the poor cooking methods, availability and accessibility, seasonality, as well as consumer's perception towards TLVs, as some of them believe that vegetable are consumed by poor people (Jarpe-Ratner *et al* 2016; Kimambo *et al.*, 2018). This situation had direct impact to the increase on malnutrition and poor health status in the country. Therefore, the current study aims to explore the availability, accessibility and household handling of TLVs.

1.2. Problem Statement and Justification

1.2.1 Problem statement

Micronutrients deficiency is a major health problem in developing country including Tanzania due to poor dietary diversity among other causes (Lotter *et al.*, 2014). Malnutrition in Tanzania is still a problem with stunting affecting 31.8% of under-five children, anaemia affecting 28.8% of women of reproductive age and minimum dietary

diversity (children) of 35.1% while Lindi region has prevalence of 23.8% of stunting, 32.5% women with anaemia and minimum dietary diversity (children) of 1.5% (URT, 2018). Despite having different species of TLVs, their dietary intake usually consists of plant based staple foods which are monotonous with very minimal variation (Stangeland *et al.*, 2009; Kinabo *et al.*, 2016).

There is a growing literature on TLVs all over the world especially in Sub Saharan Africa. However, most of these studies have concentrated on the production side of TLVs such as its agronomy (Abukutsa-Onyango, 2010), identification of TLVs species and their nutrient analysis (Bhat and Rubuluza, 2002; Ogoye-Ndegwa and Aagaard-Hansen, 2003; Abukutsa-Onyango and Karimi, 2006; Orech *et al.*, 2007; Mbhenyane 2017). Other studies have focused on the role of TLVs in food security (van Wyk and Gericke, 2000; Steyn *et al.*, 2001; Jansen van Rensburg *et al.*, 2007). A lot of studies indicated that, TLVs are very important in human nutrition and have high market potential which contribute to the household income, but to date research on availability and accessibility of TLVs has shown to be neglected by scientific and other research communities (Chagomoka *et al.*, 2013). Unfortunately, many years of research and policy in sub Saharan Africa have not effectively curtailed poor availability, accessibility and household handling practices of TLVs. There is a need to document the availability, accessibility and household handling practice of TLVs in order to increase their utilization especially in local diets in Tanzania.

1.2.2 Justification for the study

In Sub Saharan Africa TLVs are very important to improve nutrition and increase dietary diversity, especially for the rural households with low income and food insecurity. TLVs can play an important role as a source of nutrient. Consumption of TLVs ensures intake of various essential vitamins like vitamin A, B and C, and minerals like iron and zinc which

are important in solving malnutrition (Lotter *et al.*, 2014). They easily grow and adapt well to dry and unstable environment and others grow freely in the fields thus require low farm input. TLVs play an important role in enhancing household's food and nutrition security and rural livelihoods. They can also generate income when sold as when produced in excess. Decline in production, consumption and diversity of TLVs may have significant impact on the incomes especially of women farmers and nutritional status of their households (Dansi *et al.*, 2008). Currently there is a movement towards a more diversified food basket by doing research on the under-utilized crops, including the traditional foods such as leafy vegetables (Keatinge *et al.*, 2012). The study will help to reveal different factors leads to poor availability, accessibility and household handling practices which have impacts on consumption of TLVs by the rural households' farmers in Tanzania.

1.3 Study Objectives

1.3.1 General objective

Explore the availability, accessibility and household handling of traditional leafy vegetables among farming households in rural areas of Lindi region.

1.3.2 Specific objectives

- i. To assess the availability and accessibility of TLVs.
- ii. To identify existing TLVs products along the food value chain.
- iii. To describe different preparation and cooking methods of TLVs.
- iv. To identify market pathways and constraints that affect availability and accessibility of TLVs.

1.4 Research Questions

- i. What are the existing TLVs product along the value chain?
- ii. Which TLVs are available and how do they access?
- iii. What are the preparation and cooking methods of TLVs?
- iv. What are the market pathway and constraints that affect availability and accessibility of TLVs?

CHAPTER TWO

2.0 LITERATURE REVIEW

This section presents the literature review on TLVs among farming household. On the literature part there are definitions of the key concept and some previous research done on TLVs and were reviewed.

2.2 Definition of the Key Concept

2.2.1 Traditional leafy vegetables

TLVs are the plant species which are either authentic native to the specific region, or which were introduced to that region for long enough to be evolved through natural process or farmer's selection. TLVs form an important part of the cultural heritage of Africans as they play an important role in their traditions, food culture and security. Traditional Leafy Vegetable (TLVs) is synonymous with Indigenous Leafy Vegetable (ILVs), African Leafy Vegetable (ALVs) and Traditional African Vegetable (TAVs) (Mampholo *et al.*, 2016). In Tanzania the daily main meal is made up of cereal foods like rice, maize and millet flour that is usually consumed with cooked TLVs (Gowele *et al.*, 2019). Indigenous leafy vegetables refer to the vegetables which have their natural on specific area example Tanzania while TLVs are the one which were introduced over the years ago and due to the long use have become part of the food culture (Osano, 2010).

2.2.2 Market and marketing

Market can be defined in different ways. It can refer to as a specific place where by group of people buying or selling the commodities (Weldeslassie, 2007). Also can be defined as the exchange, circulation or distribution of goods or commodities between different groups of people. Based on agriculture, market refers to economic place where by

agriculture producers sell their product from the farm or field to the consumers or buyers (Osano, 2010).

Marketing refers to the way of creating, promoting and delivering goods and services to consumers. Market is the societal process which discerns consumers' wants, focusing on product or services offered. Through the technical functions of storage, processing and transportation, and through exchange, marketing increases consumer satisfaction from any given quantity of output (Osano, 2010).

2.2.3 Micronutrients

Micronutrients are the substances which required by the body in minimum amount but they are very important in proper vision, antioxidant and enhancing absorption of some nutrients in the body. They make collagen which help healing wounds, support blood vessel walls and promote healthy bones and teeth. Micronutrients involves vitamins and minerals (Lotter *et al.*, 2014; Tumwet *et al.*, 2014). Source of vitamins and minerals are fruits, vegetables and animal product. Inadequate intake of vitamins and minerals can contribute to the number of nutrition problem like anaemia, osteoporosis, hidden-hunger and undernutrition. (Merz, 2016; Gowele *et al.*, 2019). TLVs are important sources of micronutrients including vitamins A and C, and minerals like iron and zinc (Lotter *et al.*, 2014).

2.2.4 Availability

Availability refers to the overall ability of the agricultural system to meet food demand. Food production is determined by a variety of factors including land, soil management, crop selection, socio-economic and cultural factors that determine where and how farmers perform in response to markets. Production can be affected by weather variability. The

use of land, water and energy to grow food often competes with other uses which can affect food production. Food value chain and storage technologies on farms can affect the amount of food wasted in the distribution process (Hwalla *et al.*, 2016).

2.2.5 Accessibility

Accessibility refers to the affordability, allocation of food and preferences of individuals and households. Food can be direct accessed in which a household produces food using human and material resources, and economic access in which a household purchases food produced from another place. Accessibility depends on either the household has enough income to purchase food at any prices or has sufficient land and other resources to grow its own food (Hwalla *et al.*, 2016)

2.3 Availability and accessibility of TLVs

The most popular and the most widely consumed TLVs species in sub Saharan Africa include amaranth (*Amaranthus spp.*), African nightshade (*Solanum scabrum Mill*, *S. villosum Mil*), black nightshade (*S. retroflexum Dun.*), spider flower (*Cleome gynandra L.*), Jute mallow (*Corchorus olitorius and C. tridens*), pumpkin leaves (*Cucurbita pepo*, *C. maxima and C. moschata*), cowpea leaves (*Vigna unguiculata*), cassava leaves (*Manihot esculentus Crantz*, *Manihot glaziovii*), hair/bitter lettuce (*Launea cornuta (Oliv. and Hiern)*), sweet potato leaves (*Ipomoea batatas L. (Lam.)*), Water cress (*Rorippa nasturtium – aquaticum*), (Keller, 2004; Weinberger and Swai, 2006; Mampholo *et al.*, 2016; Dinssa *et al.*, 2016).

Food insecurity is one of the main causes of malnutrition and is due to multiple challenges facing farmers especially during production, inadequate quantity and quality food in order to combat widespread hunger and recently increased in food prices

(Mampholo *et al.*, 2016). In Africa, household with many members and are not supplying an income became more reliant on TLVs production, and most of the rural household know the importance of TLVs in food security. Different drying methods are used to ensure the availability of leafy vegetables during dry season or scarce (Vorster *et al.*, 2008). A year-round availability of TLVs product can be ensured through successive harvest and good storage due to their perishable nature (Tesfay *et al.*, 2016; Maseko *et al.*, 2017). Market efficiency is very important to ensure the accessibility of TLVs. Promotion of TLVs cultivation would increase their availability and accessibility to consumers and generate the household income in rural household. (Tesfay *et al.*, 2016).

2.4 TLVs Products

In Tanzania many people migrate to towns and cities far from the natural sources of fresh foods. The economical growing of these perishable commodities is limited to certain seasons and localities. During the rainy season there is an abundant supply of vegetables but they become more scarce during dry season. In order to meet the demand throughout the year in all areas, the commodities have to be preserved using different techniques. Different traditional methods are used to preserve those products and the most common in Tanzania is open sun-drying. Some of the products which are developed locally are dried cowpea leaves and jute mallow. Though the method is cheap but there are problems associated with the technique. Sometimes the technique may result in poor quality dried products because there is no control over the drying process, contamination of the product by dirt, rodents, animals, infestation by insects or moulds, and exposure of the product to rain and wind, which causes repeated wetting and re-drying. (Gyabaah-Yeboah, 1985; Galanakis, 2019).

TLVs product are important as they can ensure the availability of vegetable throughout even when there is scarcity of fresh leafy vegetable but still there are limited processed and dried products (Maseko *et al.*, 2017). In Tanzania less than 10% of the leafy vegetables are exported, this implies that household members consume fresh vegetables and very small portion is processed and developed into new products. A significant proportion of leafy vegetables is wasted due to inadequate post-harvest handling and perishable nature of vegetables (De Putter *et al.*, 2007). Vegetable losses occur due to the lack of cooled storage facilities and inadequate packaging materials and lack of knowledge on processing of TLVs (De Putter *et al.*, 2007; Mroto *et al.*, 2018).

2.5 Preparation and cooking methods of TLVs

Preparation is an initial and important stage when cooking TLVs. Most of the TLVs during preparation are peeled and/or trimmed before being cooked in order to remove the outer layers and tough skin. But excessive trimming can lead to the loss of some nutrients especially vitamin C and B which are mostly found close to the skin surface of the leafy. (Devi, 2015). TLVs are important sources of micronutrients including vitamins A, B and C, and minerals like iron and zinc (Lotter *et al.*, 2014). Food preparation and processing method affect bioavailability of micronutrients in vegetables, the use of local food preparation and processing method like direct sun drying has shown to have high impact on carotenoids accessibility on TLVs. Also cooking methods like frying showed significantly higher iron content compared to boiled ones and raw vegetables, however cooking is indicated to reduce flavonoid content. Some of the experiments show that cooking mixture of different vegetables increase the iron content compared to cooking one type of vegetables (Oluoch, *et al.*, 2012).

Since most leafy vegetables are cooked prior to consumption, it is recommended that the vegetables are cooked with small amounts of water for short periods to minimize loss of vitamin C and B, and the cooking water to be consumed if no bitter compounds are present (Bwembya *et al.*, 2018). Rural households tend to prepare their TLVs in only one way but exposure to other preparation methods will help them to reduce the loss of important micronutrients like vitamins in their diet. This would be an important step to describe preparation and cooking methods of TLVs in rural household.

2.6 Pathway Analysis of TLVs Farming and Commercialization

Marketing is the main constraint on the accessibility of TLVs and often the missing link. Small scale farmers in Tanzania are the ones that dominate the vegetable production of which majority of them are not connected to the regional market and they cannot supply to large buyers. (Aku *et al.*, 2018). In Tanzania the food value chain is complex and disorderly that brings challenge to the TLVs producers whereby vegetables are sold through different chains like local village market, regional market and supermarket (De Putter *et al.*, 2007).

In developing country like Tanzania, the value chain of TLVs is very short because leafy vegetables are very perishable. Poor transportation, processing/preservation methods, challenges of consistent supply of acceptable quality products are the challenges determining the success of producing, processing and marketing TLVs. (Dube *et al.*, 2018; Senyolo *et al.*, 2018). Lack of support from both public and private stakeholders, as very few are responsible for different service to smallholder farmers like agriculture extension or credit is also a big challenge of the leafy vegetables (Senyolo *et al.*, 2018). Low purchasing power with negative attitude on consumption of TLVs among the majority of Tanzanians leads to low level TLVs produce utilization. For instance, the daily

per capita consumption of fruits and vegetables in Tanzania was estimated at 219g in 2000 against the daily recommendation of 400g (Dhandevi and Jeewon, 2015).

Traders purchase TLVs in a very small quantity to be sold in one or two days, this is due to the lack of storage facilities which have high impact on marketing of TLVs. (Boateng *et al.*, 2016). Different studies show that high perishability of TLVs is a big challenge in the marketing and distribution of leafy vegetables, and reduce the quality soon after harvesting until consumption which also cause the price to be low (Chagomoka *et al.*, 2014; Senyolo *et al.*, 2018). In Tanzania there is lacking of good market system, where by the broker are buying product at the farm and negotiate the price of vegetables with farmers while the farmers have no or only limited information about the price, and about 80% of vegetable produced are sold to broker while 20% is sold directly to the village or town market by the farmers (De Putter *et al.*, 2007). Therefore, there is need to identify market pathways and constraints that affect availability and accessibility of TLVs in the country.

CHAPTER THREE

3.0. METHODOLOGY

3.1. Study Area

This study was conducted at Ruangwa and Nachingwea districts in Lindi region, Tanzania. Lind region is one of the 26 administrative [regions](#) of Tanzania Mainland. Lindi Region was established in 1971. The region comprises six districts namely Lindi Rural, Kilwa, Nachingwea, Liwale, Ruangwa and Lindi Urban. The regional headquarters is located in Lindi Urban District. Lindi region is situated in Southern Tanzania between latitudes 70 55' and 100 50' South of the equator and longitudes 360 51' to 400 East. Lindi shares borders with Coast region to the North, Indian Ocean to the East, Mtwara region to the South, Morogoro region to the West and Ruvuma region on the South-West. The region has an area 67,000 square kilometers (7.56% of Tanzania Mainland's area). About a quarter of the region (18,000 square kilometers) is part of the Selous Game Reserve.

The selection based on the fact that Lindi region is among the regions that suffer from all types of malnutrition. The region has prevalence of 23.8% of stunting, 32.5% women with anaemia and minimum dietary diversity (children) of 1.5% (URT, 2018). The region in spite of having different species of TLVs but still the dietary intake usually consists of plant based staple foods which are monotonous with very minimal variation. Study area is presented in Fig. 1.

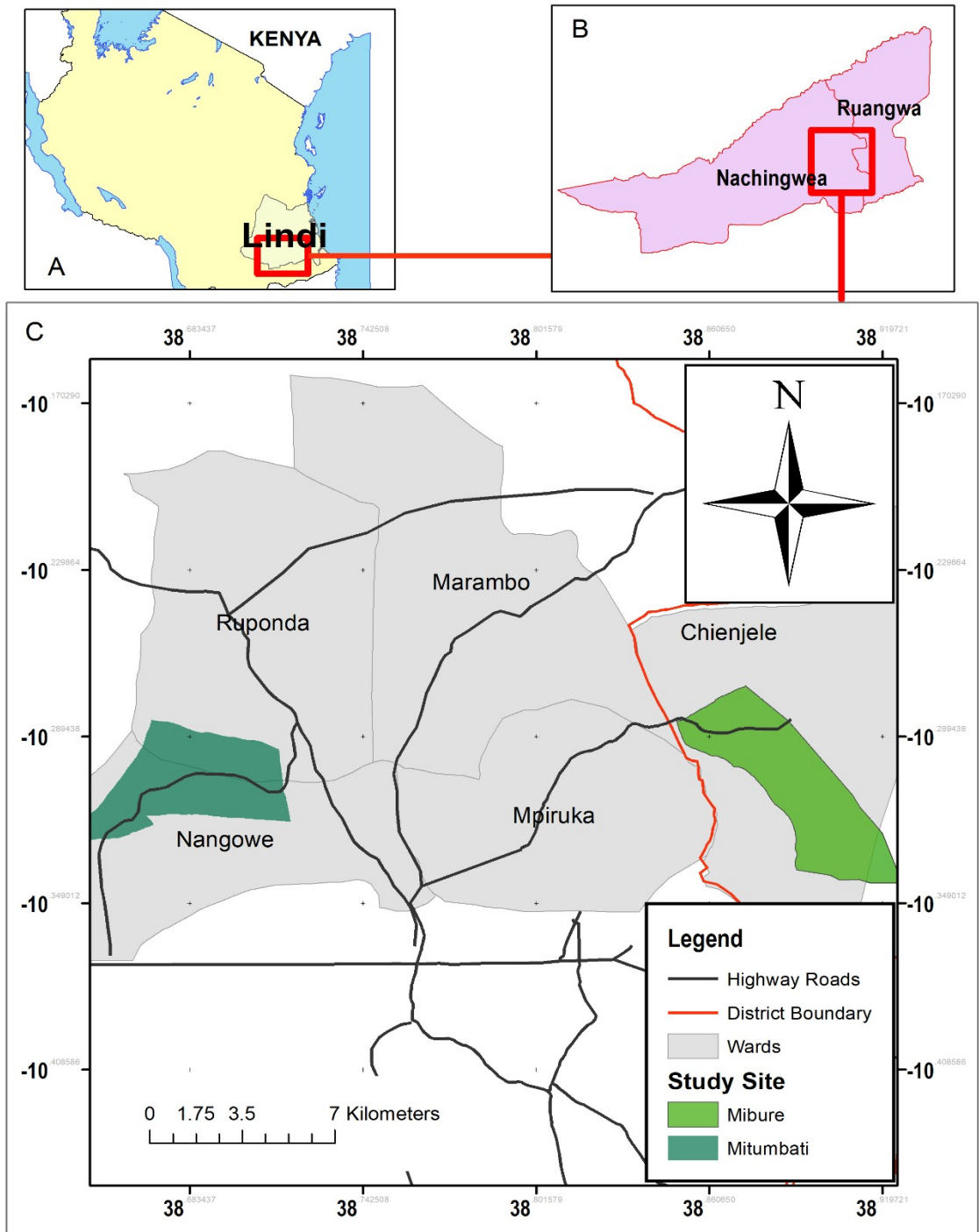


Figure 1: (A) Study area within a country (B) Study area within a Region (C) Study area within a District

3.3 Data for the Study

3.3.1 Sources of data

Data was collected from farmers and traders selling TLVs. The set of data was focused on existing TLVs products along the food value chain, the availability and accessibility of TLVs, preparation and cooking methods of TLVs, and market pathways and constraints that affect availability, accessibility of TLVs. Data were collected using checklist of questions based on existing TLVs products, the availability and accessibility of TLVs. Other data such as preparation and cooking methods of TLVs and, market pathways and constraints that affect availability, accessibility and consumption of TLVs were also collected.

3.3.2 Data collection methods

The study employed a cross-sectional qualitative-explorative study design, mainly involving KIIs, FGDs, market surveys and field walk. Both FGDs and KIIs were used to triangulate individual and group-level opinions. Qualitative interviews through FGD, KII and market surveys formed the main methods of obtaining various perspectives on the research questions related to existing TLVs products, availability and accessibility of TLVs, different preparation and cooking methods of TLVs, and market pathways and constraints that affect availability and accessibility of TLVs. Qualitative interviews give a new insight into a social phenomenon as they allow the respondents to reflect and reason on a variety of subjects in a different way (Folkestad, 2008).

3.3.2.1 Focus group discussions

Focus Group Discussions are designed to learn about subjects and/or get information, understand different activities of the subjects and their perceptions in a certain community which cannot be directly observed (Keding *et al.*, 2007). In each study village three FGD

were conducted which involved 10 farmers, making a total of six focus discussions for the two villages. The first set of groups involved both male and female farmers, second set involved female farmers only and the third set involved male farmers. In both villages Mitumbati and Mibure focus group discussions involved 10 participants both male and female in the same ratio, 5 females and 5 males. Therefore, the total participants in focus group discussions were 60.

Before conducting the FGD, the aim and purpose of the study was explained in every focus group discussion. During discussions, a voice recorder was used to collect data on existing TLVs products, availability and accessibility of TLVs, preparation and cooking methods of TLVs, and market pathways and constraints on availability and accessibility of TLVs in order to get all the important information from the participant.

3.3.2.2 Key informant interviews

Key informant interview is a one to one interview which involves face to face or through phone communication technique designed to collect in-depth information from the people who know what is going on in the community including professionals, community leaders and residents who have the first-hand knowledge about the community (Keller, 2004). In each study village, six key informant interviews which involved extension officer, District Agriculture Irrigation and Cooperative Officer (DAICO), community development officer, village chairperson and two residents who lived in the village for more than 3 years were interviewed, 25 traders from each village were conducted, making a total of 62 interviews altogether. A voice recorder was used to record all the information from the respondents. A checklist of the guided questions for discussion was used. The questions about availability and accessibility of TLVs, market pathways and constraints on

availability and accessibility of TLVs, and existing TLVs product were included in the checklist.

3.4 Sample Size and Sampling Procedures

A stratified multistage sampling approach was used in selecting respondents. In the first stage, a purposive sampling was used to select Lindi region which has prevalence of 23.8% of stunting, 32.5% women with anaemia and minimum dietary diversity (children) of 1.5% (URT, 2018). The region in spite of having different species of TLVs but still the dietary intake still consists of plant based staple foods which are monotonous with very minimal variation.

In the second stage, a purposive sampling was employed to select two districts (Ruangwa and Nachingwea). These districts are identified as major areas where most of TLVs are produced and/or consumed. Lindi Region is rich in natural resources and has land suitable for agriculture, irrigation, forestry and industrial development. It has a mixed economy, whose main sources of income are agriculture, business, fishing, construction and manufacturing, and livestock keeping. There have been a growing number of investments such as liquefied natural gas, cashew farming, vegetables and sesame production (URT, 2019).

The third stage involved stratification of the area producing TLVs within the selected districts. Whereby, two (2) villages (one in each district) Mitumbati and Mibure were chosen. In each selected village, a random sampling of 25 traders of TLVs for market survey was drawn, 6 key informants were drawn, and 3 FGDs were held.

3.5 Method of Data Analysis

The study employed the use of content analysis with the use of NVivo 12, qualitative data analysis software (QDAS) developed by QSR International on 2018. Content analysis is a research method used to determine the presence of certain words, themes, or concepts within some given qualitative data (Marshall and Rossman, 1990). The content analysis was used to quantify and analyze the presence, meanings and relationships of themes and concepts. Qualitative data analysis used to pursue the relationship between categories and themes of data seeking to increase the understanding of the phenomenon. The voice records from FGDs and KII were transcribed and translated, then formation of code book for result categorization and analysis. The code book contain themes obtained in the field based on the availability and accessibility of TLVs, identify existing TLVs product, household handling practices of TLVs and, market pathway and constraints that affect availability and accessibility of TLVs. NVivo software analyzes the data in form of colored graphical tables for the interpretation.

CHAPTER FOUR

4.0 RESULTS

The chapter provides the summary of the actual results of the data collected and discussion on the study topic availability and accessibility of traditional leafy vegetables among rural farming households in rural areas of Lindi region. The chapter is divided into subsections which include social demographic characteristics, availability and accessibility of TLVs, preparation and cooking methods of TLVs, TLVs Product and pathway analysis of TLVs farming and commercialization.

4.1 Social Demographic Characteristic

Some aspects were considered in demographic characteristic including age, sex, academic qualification and occupation of the respondents. Table 1 and 2 summarizes characteristics of KII participants. Most of the respondents in KII 27 were between the ages of 20-30 years, followed by 17 respondents who were between the ages of 31-40 years, 7 participants were between the ages of 41-50 years, 6 participants were between the ages of 51-60 years and, 2 and 1 respondents were between 71-80 and 81-90 years respectively. The majority of respondents (40) were male. The education level of the majority of the respondents (46) were primary level and 4 had a secondary education (form four). Based on the occupation, the majority of the respondents (42) were both farmers and traders, followed by 8 traders, 2 of them were extension officers and 3 of them were village leaders, 6 influential people and DAICO.

Table 1: KII for farmers and traders

Demographic Characteristics		(n=50)
Age		
20-30		27
31-40		15
41-50		4
51-60		4
Total		50
Sex		
Male		31
Female		19
Total		50
Academic qualification		
Primary		46
Secondary		4
Total		50
Occupation		
Framers and Traders		42
Traders		8
Total		50

Table 2: KII

Demographic Characteristics		(n=12)
Age		
31-40		2
41-50		3
51-60		2
70+		5
Total		12
Sex		
Male		9
Female		3
Total		12
Occupation		
Extension officer		2
Village leader/Chairperson		3
Influential /Farmers		6
DAICO		1
Total		12

Characteristics of FGD participants summarizes in Table 3. The majority of respondents in FGDs (26) were between the ages of 20-30 years, followed by 18 respondents who were between ages of 31-40 years, 10 participants were between the ages of 41-50 years

and 6 who were between the ages of 51-60 years. All of the respondents were farmers.

Moreover, female and male respondents were on the same ratio.

Table 3: FGD for farmers

		Demographic Characteristics	(n=20)	
FGD 1	Age	20-30	9	
		31-40	7	
		41-50	2	
		51-60	2	
		Total	20	
	Sex	Male	10	
		Female	10	
		Total	20	
	Academic qualification	Primary	17	
		Secondary	3	
		Total	20	
	FGD 2	Age	20-30	10
			31-40	5
41-50			3	
51-60			2	
Total			20	
Sex		Male	20	
		Total	20	
Academic qualification		Primary	16	
		Secondary	4	
		Total	20	
FGD 3		Age	20-30	7
			31-40	6
			41-50	5
	51-60		2	
	Total		20	
	Sex	Female	10	
		Total	20	
	Academic qualification	Primary	20	
		Total	20	

4.2 Availability and accessibility of TLVs.

4.2.1 Availability

Though there are different varieties of TLVs existing in the study area, but the availability of these vegetables depends on seasonality. During rainy season TLVs become readily available compared to the dry season when they are scarcer. During FGD and KII, TLVs mentioned to be available during rainy season and dry season are presented in Table 4.

Table 4: Existing TLVs during rainy season

English name	Local name
Amaranth leaves	<i>Mchicha chawa/tindi pori</i>
Cassava leaves	<i>Kisamvu</i>
Cowpea leaves	<i>Safwe/majani ya kunde</i>
False sesame	<i>Nkwiyamani</i>
Jute mallow	<i>Mlenda ufuta/linyoro,</i>
Pumpkin leaves	<i>Majani ya maboga</i>
Sweet potato leaves	<i>Matembele</i>
Wild amaranth	<i>Mchicha bwasi</i>
Wild cowpea	<i>Chikundewa</i>
Spider flower plant	<i>Mgagani</i>
Moringa oleifera	<i>Mlonge</i>
-	<i>Mkokobwado</i>
-	<i>Mtolilo</i>
-	<i>Namdelele</i>
-	<i>Nakache</i>
-	<i>Mtimbamwisi</i>

Most of the TLVs available during dry season are cultivated in the low land like cassava leaves, sweet potato leaves as well as amaranths, and few of them are cultivated at home in the home gardens like sweet potato leaves, amaranths, cowpea leaves and pumpkin leaves due to the scarcity of water. When participants were asked during both FGDs and KII about the TVLs mostly consumed, amaranth was shown to be mostly preferable followed by pumpkin leaves, sweet potato leaves, cassava leaves and cowpea leaves. The majority of participants mentioned the availability of TLVs and preference to be the reasons why these TLVs are mostly consumed, and few participants mentioned deliciousness to be one of the reasons why the above TLVs are mostly consumed by the

household in the study area. During FGD participants mentioned the TLVs which are uncultivated like *mtimbamwisi*, *nakache*, *namdelele*, *mtolilo*, *mkokobwado*, jute mallow (*lilende*, *mlenda ufuta/linyororo*), false sesame (*nkwiyamani*), and amaranths (*mchicha chawa/tindi*). Fig. 2 present the TLVs which are uncultivated.



Figure 2: (a) Mtimbamwisi; (b) Namdelele; (c) Mkokobwado; (d) Wild cowpea leaves

4.2.2 Accessibility

In the FGD, accessibility of TLVs was shown to be affected by distance from the low land where farmers cultivate vegetables for consumption. Also lack of permanent market in the village which made the farmers to travel with the bicycles to the town market to sell their

leafy vegetables. Further discussion with KII indicated that quality, quantity and high price of leafy vegetables during dry season have direct impact with the consumption of TLVs. The TLVs consumption per week during both rainy season and dry season is indicated in Table 5. Moreover, in the focus group discussions pumpkin leaves, cassava leaves, amaranths, *nandelele*, *mlonge* and *chikundewa* were mentioned to be consumed 2-4 days per week, this may be due to the high accessibility of TLVs during rainy season. Cassava leaves, amaranths and *mtimbamwisi* were mentioned to be consumed 5-6 days per week during dry season, this may be due to poor accessibility which lead to poor diversification of the TLVs during the season. Moreover, during both FGD and KII when participants were asked to mention what are the mostly consumed TLVs in the study area, amaranths was mentioned to be highly consumed followed by sweet potato leaves, pumpkin leaves, cowpea leaves and cassava leaves, this is due to high accessibility of these TLVs even during dry season because they are cultivated.

Table 5: Consumption of TLVs per week during both dry and rainy seasons by rural households

Type of TLVs available	Consumption of TLVs per week (Rainy season)	Consumption of TLVs per week. (Dry season)
Pumpkin leaves	2-4	5-6

Cowpea leaves	5-6	2-4
Cassava leaves	2-4	5-6
Sweet potato leaves	2-4	5-6
Amaranth	2-4	5-6
<i>Mkokobwado</i>	Not consumed because it contain a lot of water during the rainy season	2-4
<i>Tindi</i>	5-6	Not available
<i>Lilende</i>	2-4	Not available
<i>Nandelele</i>	2-4	Not available
<i>Mtimbwamwisi</i>	Not available	5-6
<i>Linyororo</i>	2-4	Not available
<i>Mlonge</i>	Ones	2-4
<i>Chikundewa</i>	Ones	Not available

4.3 TLVs Products

Based on FGD it was indicated that recently there are very few people who locally process and develop TLVs products like dried cowpea leaves and *linyororo* (jute mallow) at the household level. Preparation steps of the product are presented in Table 6. But long time ago, their ancestors used to process and store leafy vegetables like cowpea leaves *linyororo* (jute mallow) as well as cassava leaves. Furthermore, in discussions with key informants, it was reported that there are few people who make TLVs products at household level. This may be due to lack of knowledge on processing and preservation to ensure pro-longed availability and accessibility of TLVs. On the other hand, during the focus group discussions one of the village leaders said “*recently most of the villagers do not dry vegetables like cowpeas leaves because it involves a lot of procedures which consume time*”. When participants were asked about what products from TLVs should be developed, the majority mentioned dried cowpea leaves followed by cassava leaves and sweet potato leaves. These were suggested by both farmers and traders during KII. They proposed dry products to be developed, which are likely to be accepted by the rural households to ensure the availability and accessibility of green leafy vegetables throughout the year.

Sun-drying is highly practiced as one of the preservation methods of different crops, vegetables and fruits. The method is accepted because it is easy to use and do not use energy sources. During FGD, cowpea leaves were boiled, adding some salt, pour out water and dry to an open sun drying. It takes two to three days to be dried, then dried cowpea leaves are stored in the pots or tins for future use.

Table 6: TLVs products

TLVs	Processing methods	Product
Cowpea Leaves	-Harvested, sorted, trimmed and washed - Salt is added and boiled for few minutes -Pour out water then dried to an open sun drying -It takes two to three days to be dried then stored in the pot for future use.	Dried cowpea leaves
Jute mallow (<i>Linyororo</i>)	-Sorted and trimmed -Dried to an open sun drying -It takes two days to be dried -Pounded to a wooden handicraft	Powdery (<i>Linyorosro</i>)

4.4 Preparation and Cooking Methods of TLVs

4.4.1 Preparations of TLVs

During FGD different preparation methods were mentioned. Some participants mentioned to collect leafy vegetable in the morning while others collect at the time when they need to cook. If the vegetables are clean, they do not wash them and if they containing sands, they wash them and remove other residues. Peeling is done for most of TLVs like sweet potato leaves, pumpkin leaves, amaranths and cowpea leaves so as to remove debris and separate the edible and inedible parts. Some of the participants mentioned that TLVs are cut into small sizes, washed and squeezing so as to reduce water. Furthermore, during FGD some of the participants mentioned, after peeling TLVs they wash them so as to remove other impurities and sands then cut into smaller sizes.

4.4.2 Cooking methods

In the FGD, different cooking methods were mentioned which include; boiling and prolonged cooking while covering the vegetables. The participants reported that during cooking, they usually leave the pot boiling and continue with other activities, this indicates that the TLVs are cooked for a long time because sometimes they forget if the food is still on the fireplace and becomes overcooked. Sodium carbonate (*magadi*) is added to some vegetables such as jute mallow (*mlenda*) during cooking to improve taste, reduce viscosity and increase softness. But also, participants reported to fry TLVs with tomatoes and onions except for cassava leaves and *tindi*. For the case of cowpea leaves some of them boil it for some time then pour out water then continue cooking which indicate that there is loss of some nutrients due to the pouring of boiled water. Table 7 and 8 present preparation and cooking methods of fresh and dried TLVs respectively.

Table 7: Preparation and cooking practices of TLVs

TLVs	Preparation and cooking methods
Cassava leaves	<ul style="list-style-type: none"> - Collected from the farm when they want to cook - Sorted and then pounded in the wooden handicrafts - Pounded cassava leaves put in the pot, water is added and boiled - Grinded ground nut or cashew nut or sometimes oil were added then boiled for sometimes until its ready to eat.

Pumpkin leaves	<ul style="list-style-type: none"> - Pumpkin leaves, its flowers and immature pumpkins were collected. Leaves were peeled, sorted, and cut into small size then wash. Few of them wash then cuts into small size. - Put into the boiling water, then salt and tomatoes were added and leave to boil for sometimes while pot is covered - Some of them add oil - During dry season they add Sodium Carbonate because the leaves are mature and become hard to be cooked
Sweet potato leaves	<ul style="list-style-type: none"> - Collected, peeled, sorted then expose to the sun for some time to let them shrink (reducing water content from the leaves) - Pot was placed to the fireplace then oil, onion, salt and tomato were added followed by leaves vegetables. - Wait for sometimes until the food is ready
Cowpea leaves	<ul style="list-style-type: none"> - Collected, peeled, sorted then wash - Boiled in the pot for few minutes then salt, oil, onion and tomato are added. - Few of them were boiling and pour some water, then continue to boil until the food is ready
Amaranth	<ul style="list-style-type: none"> - Collected, peeled, sorted then washed - Oil, onion and tomatoes are added, then cooked for some time amaranth is then added and cooked for few minutes then ready to eat. - Sometimes they boil amaranths then pour some water, put a pot on the fireplace then oil, onion, tomatoes and the boiled amaranths are added. Let it boil for sometimes and ready to be saved

Table 8: Preparation and cooking method of dried TLVs

Type of TLVs	Preparation and cooking method
Dried cowpea leaves	<ul style="list-style-type: none"> - Dried cowpea leaves were added into the boiling water and let to boil for few minutes. - Salt, onion and tomato were added. - Then, cooking for few minutes and the food will be ready to eat.
<i>Linyororo</i> (Jute mallow)	<ul style="list-style-type: none"> - Cold water is added, followed by dried powdery jute mallow, place the fireplace and

cook for few minutes until looked like porridge then ready for consumption.

4.5 Market Pathways and Constraints that Affect Availability and Accessibility of TLVs

The major challenges which were mentioned by farmers during the FGDs and KII in farming and marketing of TLVs included; poor access to credits, land, agricultural training, agricultural technology like proper irrigation, poor preservation methods, distance to the market and lack of capital. On the other hand, seasonality, seeds whereby they use their own local seeds, they stored themselves which can sometimes leads to low production, lack of agriculture inputs were named to be factors affecting the availability of TLVs. Various plants diseases and pests were mentioned during FGDs and KII as the biggest challenges which complicate farmers' activities. Protection against these is important as dangerous insects like caterpillars and diseases such as white spots which cause low production and low quality of TLVs are common in the areas

Similarly, lack of proper irrigation techniques and lack of reliable/permanent water sources were mentioned during FGDs to be a serious challenge for farming. Irrigation is highly important for the improvement in farming activities. Based on the discussions during FGD and KII, some factors were mentioned to affect accessibility of TLVs which included; lack of information about markets, TLVs available at local markets, distance to nearest market, price which ranged from 300TZS to 500TZS during rainy season while 500TZS to 1000TZS for one batch of TLVs during dry season which is very high and not all people are able to afford it due to their low income, seasonality, infrastructure (transportation) and low production.

CHAPTER FIVE

5.0 DISCUSSION

5.1 Social Demographic Characteristics

Age, experience and education level were considered in demographic characteristics as the factors which have high contribution in agricultural activities. Age of the farmers constitute maturity, emotional adulthood and physical ability in decision making and physical activities (Kuntariningsih and Mariyono, 2013). From the current study most of the farmers are between the age of 20-30 years. Effect of age on technology adoption depends on time, meaning that positive impact occurs at certain ages and become negative when farmers are getting older (Kuntariningsih and Mariyono, 2013). Majority of the respondents had a primary level of education and very few had secondary level (form four). Educational level of the farmer reflects the human capital, meaning that the higher level of human capital leads to more cogent decision making on the use of agricultural technologies as well as investment on different TLVs production.

A study done by Mariyono *et al.* (2017) show that education level contributes to decision making on the use of agriculture technologies and investments on vegetables production. Experience of farmers in vegetable farming constitute a farmer's familiarity with vegetable production, which is considered more multiplex than for cereal crops. Based on the study most of the farmers shown to have experience in farming activities for more than five years, this help them to predict on production and marketing based on seasonality and climatic condition. The study done by Kuntariningsih and Mariyono (2013), shown that more experienced farmer in vegetable farming anticipated to commercialize farming activities at a higher level.

5.2 Availability and accessibility of TLVs.

The study showed that TLVs are well known by the majority of the rural households. Despite the availability of many species of TLVs few of them are cultivated in both low land and home gardens like cassava leaves, sweet potato leaves, amaranths, cowpea leaves and pumpkin leaves especially during the dry season. During rainy seasons there is high availability of TLVs due to the favorable conditions which allow them to grow well. The season allows the growth of TLVs which are not planted like *mtimbamwisi*, *nakache*, *namdelele*, *mtolilo*, *mkokobwado*, jute mallow (*lilende*, *mlenda ufuta/linyororo*), false sesame (*nkwiyamani*), and amaranths (*mchicha chawa/tindi*) which increase their availability and accessibility to the rural households. The mostly consumed TLVs are amaranth followed by pumpkin leaves, sweet potato leaves, cassava leaves and cowpea leaves because they are mostly available and preferred by the rural household. Other studies in other areas in Tanzania also reported that amaranths, African nightshade, and sweet potato leaves to be vegetables that are mostly consumed (Afari-Sefa *et al.*, 2016).

There is no permanent market where rural household can access TLVs. The majority of farmers sell their TLVs around the streets, and some of them sell from the place where they are cultivated (gardens). The price varies according to the season, in that during rainy season it ranges from 300TZS to 500TZS for one butch TLVs while during dry season it ranges from 500TZS to 1000TZS for one butch of TLVs which have direct impact on accessibility of TLVs. The study done by Maro (2008), showed that high price in rural areas affects accessibility of TLVs. Seasonality was shown to be another factor that affect the accessibility of TLVs by the rural households (Osano, 2010).

5.3 TLVs Products

Sun-drying is highly practiced as one of the preservation methods of different crops, vegetables and fruits. During the processing methods there might be improper sorting, peeling, washing and boiling that can lead to loss of micronutrient like vitamins which are soluble in water, also they can be contaminated with sand or microorganism (FAO, 1985; Devi, 2015; Bwembya *et al.*, 2018). Jute mallow (*Linyororo*) after harvested, is sorted and trimmed then expose to an open sun drying. After two to three days become dry and pounded to a wooden handicraft become powdery as the end product. The exposure of TLVs to an open sun drying can leads to the loss of pro-vitamin A carotene which are very important to human body the study done by Mulokozi and Svanberg (2003), supported the current findings showing the loss of pro-vitamin A-carotenes on the open sun-drying.

This study reveals that there are very few people who practice drying of TLVs and storing for future use, especially during dry season when they are scarce. The drying process of different TLVs is done at household level, meaning that there are no any products of TLVs on the market in the study areas. Dried cowpea leaves, cassava leaves and sweat potato leaves were the products suggested by the participants to be developed. A study was done by FAO (1985) which aimed to develop products of dried TLVs like cassava leaves, cowpea leaves, *mlenda* (*Ocho sp. Corchorus sp.*) and *mchungu* (*Lctuca capensis*). The developed products were very nutritious and palatable for consumption to ensure food security. Then the products were introduced to the market and performed well because they were accepted by consumers. On the other hand, a study done by (Mulokozi *et al.*, 2000) showed that there were different TLVs like amaranths and pumpkin leaves which are dried and store to be used in dry seasons.

5.4 Preparation and Cooking Methods of TLVs

During preparation, most of vegetables are peeled and, or sometimes trimmed before cooking so as to remove the tough skins and the outer skin in order to remain with edible parts. But most of the nutrients which are present in TLVs lies close to the skin surface, thus excessive trimming or peeling have high impact on reducing/removing the nutrients like vitamin C and B (Devi, 2015). As mentioned above some of the participants after peeling TLVs they cut them into small size then wash and squeeze to reduce water, this leads to the loss of the nutrients like vitamin B and C which are soluble in water (Henry and Massey, 2001; Devi, 2015). In order to minimize loses of the vitamins, peeling and trimming process should be minimized without affecting the palatability of the TLVs. Also, during preparation of TLVs washing process is very important to remove sand and other residuals but should be done before cutting with minimum or no squeezing so as to reduce loss of soluble vitamins like vitamin B and C.

During preparation of sweet potato leaves, the majority of the respondents reported that after peeling of TLVs they expose them to the sun for some minutes in order to reduce moisture content. The exposure of the TLVs into open sun-drying has impact on the loss of some nutrients especially water soluble vitamins such as vitamin B and C. The study done by Mulokozi and Svanberg (2003), supported the current findings showing the loss of provitamin A-carotenes on the open sun-drying.

Boiling was reported be one of the cooking methods which is highly practiced. Boiling and pouring out water can lead to the loss of water-soluble vitamins like vitamin B and C which are very important in human's body. Research shows that boiling of vegetables and pouring out the remaining water causes the soluble vitamins to be leached to the poured water (Devi, 2015; Kinabo *et al.*, 2016; Bwembya *et al.*, 2018). Since most of the leafy

vegetables are cooked prior to consumption, it is recommended that the vegetables are cooked in small amounts of water for short periods to minimize loss of vitamin B and B, and the cooking water to be consumed if no bitter compounds are present (Bwembya *et al.*, 2018). It was noted that the majority of rural households use Sodium Carbonate (*magadi*) when cooking jute mallow (*mlenda*) in order to reduce the viscosity, improve taste and increase softness. Addition of sodium bicarbonate into the vegetables leads to the decrease amount of minerals like iron and zinc which are important micronutrients needed by the body (Kinabo *et al.*, 2016).

5.5 Market Pathways and Constraints that Affect Availability and Accessibility of TLVs

During FGD and KII price of the vegetables sold and capital presented by the farmers to be one of the challenges which affect availability of TLVs. Studies done by Maro (2008) and Keding *et al.*, (2007) indicated that price, capital and high cost of agriculture inputs like fertilizers and pesticides to be the constraints that affect both availability and accessibility of TLVs. Also, the distance from the farm to the market and poor transportation which lead to damage and loss due to perishability of leafy vegetables. It was confirmed that, dependable information about the market which include price of vegetables and information where to sell vegetables were missing (Misaki *et al.*, 2016). In developing countries, the value chain of TLVs is very short because leafy vegetables are very perishable. Poor transportation, poor processing/preservation methods, consistent supply of acceptable quality products are the challenges determining the success of producing, processing and marketing TLVs (Dube *et al.*, 2018; Senyolo *et al.*, 2018).

Other challenges which affect availability and accessibility of TLVs are poverty and lack of resources. This causes the farmers to work under very challenging environments with

poor farming inputs. Farmers lack means of information about market, capital and ways to improve their living conditions so as to reduce poverty which put them in a weak position in the agriculture production chain. Distance to market TLVs and transport infrastructure are other challenges, since better transportation can reduce the distance from farms where TLVs are produced to the markets for remotes areas and rural communities as rural roads can increase the market access. Other issues identified in this study were weather variability which sometimes affect the traditional prediction of weather, this can sometimes cause loss of vegetables by either being dried or submerged by flood water. Lack of improved or certified seeds as most of the farmers use their own local seeds which sometimes can be easily affected by insects, pets and diseases leading to low production. The access to agricultural inputs, technologies and market information to the farmers especially in remote areas will help to increase the production of TLVs and make them available, as well as easily accessible by consumers.

CHAPTER SIX

6.0 CONCLUSION AND RECOMMENDATIONS

6.1 Conclusion

The study revealed that TLVs are available and they are highly accessible during the rainy season but became less available during dry season which lead to the increasing in the scarcity and price of TLVs. Therefore, the higher the price, the less affordable for rural households to purchase leafy vegetables. There is inadequate knowledge on processing and preservation methods which lead to the loss especially during the rainy season when the leafy vegetables are highly available in the area. The study also highlights the different preparation and cooking methods which contribute to the loss of nutrients especially soluble vitamin B and C which are water soluble due to excessive trimming, washing and squeezing. Seasonality, lack of improved seed, transportation, absence of permanent market and lack of market information seem to be the factors affecting the availability and accessibility of TLVs.

6.2 Recommendations

- i. Availability and accessibility of TLVs, infrastructure, agricultural technology, market information, preservation and processing knowledge are the key areas that should be addressed by the government at policy level. Investments should be made towards improving transportation infrastructure in the remote areas so as to increase the accessibility of the market by farmers. There should be permanent markets in the rural areas so as to ensure the accessibility of TLVs. Markets should be improved by adopting appropriate post-harvest handling practices like sorting, grading, cleaning, packaging, cold storage facilities and refrigerated transportation.

- ii.** Future efforts need to look into the best ways to provide contextualized irrigation solutions. The role of technology in improving irrigation, providing education about irrigation and solutions to farmers needs to be approved in the future. Provision of knowledge to the rural household farmers about diseases which affect TLVs and how to control them in order to improve quality of the produce should be observed.

- iii.** The Ministry of Agriculture should integrate preparation and cooking practices with agriculture interventions to equip rural household farmers with the knowledge on how to prepare nutritious food without losing important nutrients like vitamins which are easily lost.

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APPENDICES

Appendix 1: Guideline for focus group discussion

Section I: Background information (farmers/producers)

I would like to thank you all for coming and agreed to participate in this discussion.

Before we start our discussion, I would like to have a self-introductory among members.

I am interested to know your names, and how long have you lived in this community?

Age..... Gender..... Household size.....

Education level.....

- a. How have livelihoods / activities required as means of living changed?
- b. How have markets changes?

Section II: Crop production

1. What vegetables grow best in this area? Of grown green leafy vegetables
 - a. Which one are mostly used for selling?
 - b. Which one are mostly consumed?
2. Where did you get seeds for green leafy vegetables?
3. Who participate on production green leafy vegetables (probe preparation of farm, weeding, harvesting, storage and marketing)
4. Does the production of traditional leafy vegetables change for the past 3 years?

How has it change and what are the reasons for change?

Section III: Preparation and cooking methods

1. How soon do you cook your leafy vegetables after picking them?
2. How do you prepare them before cooking?
3. How long do you cook leafy vegetables?
4. What method do you use to cook your leafy vegetables?
5. What traditional processing methods exist?
6. What green leafy vegetables are processed and stored for household food security?
7. How do you process it? (*try to probe for steps used in processing*)

8. Do you think there are other ways of preparing leafy vegetables to increase the shelf life? What do you think could be a best way to prepare it to increase shelf life?

Section IV: Marketing (selling and buying)

1. Which form/kind of vegetables do farmers sell? (probe for green vegetables, dried vegetables, both exotic and traditional)
2. Do the sales of Vegetables change for the past 3 years? How does it change and what are the reasons for change?
3. How is the price determined? probe for
 - a. *Price differences in term of vegetables varieties (green vegetables, dried vegetables) and the reasons for price different)*
4. How does the amount of traders/buyers change over the past three years? What is the reason for change?
5. What quality do buyers prefer?
6. What are the market challenges? (Probe for infrastructure, market conditions, challenges faced by sellers and buyers?)
7. Who are key actors of market of vegetables? Why?
8. What do you think are market opportunities for Vegetables?
9. In your opinion what are best ways of increasing market opportunity for vegetables?

(Probe for possible products to be developed, the processing methods/techniques, raw materials to be used and consumer of the developed product, ask also for packaging material and size, marketing methods, existing regulations that promote or hinder marketing)
10. What are society attitudes towards new developed product? Start by ask if there was product developed earlier, what success and what are failure

Appendix 2: Guideline for Key Informant Interviews (District and village/ward extension officer)

Guidance for self-introduction and the purpose of the interview:

Section I: Background information (farmers/producers)

I would like to thank you all for coming and agreed to participate in this discussion. Before we start our discussion, I would like to have a self-introductory among members. I am interested to know your names, and how long have you lived in this community?

Age..... Gender..... Household size.....

Education level.....

Section II: Production

5. Which green leafy vegetables grow best in your area? (probe for both cultivated and indigenous)
6. Which green leafy vegetables are used as a source of income? Why?
7. Which green leafy vegetables are mostly consumed and why?
8. Where did you get seeds for TLVs for the ones you cultivate?
 - a. Who participate on production of TLVs (probe preparation of farm, weeding, harvesting, storage and marketing)
 - b. Has the production of vegetables changed for the past 3 years? How has it change and what are the reasons for change?

Section III: Marketing (selling and buying)

11. Do you buy/sell green leafy vegetables?
12. What is the buying price?
13. What qualities are preferred?
14. How did you transport to the market?
15. Who do you sell to? (ask also reason for selling to them)
16. What is the price range when you sell?
17. What qualities affect the price when you sell?
18. In what state do farmers sell green leafy vegetables? (probe for green, dried, processed)
19. Who are main buyers of green leafy vegetables?
20. Who are main buyers of dried one?
21. What are the market challenges for green leafy vegetables? (Probe for infrastructure, market conditions, challenges faced by sellers and buyers?)
22. In your opinion what are best ways of increasing market opportunity for vegetables? (*probe for possible products to be developed, the processing methods/techniques, raw materials to be used and consumer of the developed product, ask also for packaging material and size, marketing methods, existing regulations that promote or hinder marketing*)
23. Are there any products of green leafy vegetables?
24. If yes, what are they... (ask what success and what are failure of that product)
25. If no, do you think if we develop vegetables product will it be accepted?
26. What are societal attitudes towards new developed product?

Section I: Background information (Traders/Consumers)

I would like to thank you all for coming and agreed to participate in this discussion. Before we start our discussion, I would like to have a self-introductory among members. I am interested to know your names, and how long have you lived in this community?

Age..... Gender..... Household size.....

Education level.....

Section II: Consumption

1. Which green leafy vegetables are available in your area? (probe for both cultivated and indigenous)
2. Which green leafy vegetables re mostly consumed and why
3. Where did you get seeds for green leafy vegetables for the one you cultivate?
 - a. Who participate on production of vegetables (probe preparation of farm, weeding, harvesting, storage and marketing)
 - b. Has the production of vegetables changed for the past 3 years? How has it change and what are the reasons for change?
4. Which vegetables are used as a source of income? Why?

Section III: Marketing (selling and buying)

5. Where did you buy green leafy vegetables from? (ask for market place, village, if from producers or middle man)
6. What is the buying price of green leafy vegetables?
7. How is buying price determined? (probe factors influencing to pay the price offered)
8. What qualities are you preferred?
9. How did you store your product after purchase?
10. What qualities affect the price?
11. In what state do farmers sell green leafy vegetables? (probe for green, dried, processed)
12. What are the market challenges for vegetables? (Probe for infrastructure, market conditions, challenges faced by sellers and buyers?)
13. In your opinion what are best ways of increasing market opportunity for vegetables?
(probe for possible products to be developed, the processing methods/techniques, raw

materials to be used and consumer of the developed product, ask also for packaging material and size, marketing methods, existing regulations that promote or hinder marketing)

14. Do you process, sort, clean, dry or pack green leafy vegetables before selling?
15. Do you think there is any importance of processing vegetables? (ask them for possible products to be developed, where and by whom)
16. What processed product do you think will perform best in the market and why?